points of the MR spin filter effect and the shunt reduction in the upper free layer. For this, needed is a technique of using an ultra-thin spacer of Cu having a low Hin. In the constitution having a laminate Ru/Cu film, where the underlayer is of 1.5 nm Ru/1 to 2 nm Cu, the free layer of CoFe is an ultra-thin free layer having Ms×t of 3.6 nm and a thickness of 2 nanometers, and the spacer Cu has a thickness of 2 nanometers, Hin could be from 7 to 13 Oe or is low. Considering the fact that Hin in the embodiments of (7-1) and (7-2) is around 20 Oe, the Hin reduction in the embodiments (8-3) and (8-4) is significant.

For Hcu calculation, σt shall be obtained from the specific resistance of Ru in terms of Cu having 10 microohm centimeter. The specific resistance of Ru as obtained in experiments is 30 μΩcm. For the shunt effect, the thickness of Ru could be 1/3 of that of Cu having a specific resistance of 10 μΩcm. For example, the shunt in the constitution of 1.5 nm Ru/1 nm Cu could be equivalent to that in Cu of (1.5 nanometers/3) + 1 nanometer = 1.5 nanometer in thickness.

In variations of the embodiments (8-1) to (8-4), a noble metal element film may be further laminated over the antiferromagnetic film. For example, employable is any of a single-layered or laminated films of Cu, Ru, Pt, Au, Ag, Re, Rh, Pd, etc. In those constitutions, low Hin could be realized even when the spacer film therein is thin. However, if the

laminated film is too thin, the current flow ratio will be large in the upper free layer. Therefore, the thickness of the single-layered or laminated film preferably falls between 0.5 nanometers and 3 nanometers or so.

Example 3: Bottom SFSV (with NiFe/Co(Fe) free layer)

5 nanometer Ta/2 nm Ru/10 nm PtMn/2 nm CoFe/0.9 nm Ru/2.5 nm CoFe/2 nm Cu/0.5 nm Co/2 nm NiFe/2 nm Cu/5 nanometer Ta

(9-1)

5 nanometer Ta/1 nm Ru/2 nm NiFeCr/7 nm IrMn/2 nm CoFe/0.9 nm Ru/2.5 nm CoFe/2 nm Cu/0.5 nm Co/2 nm NiFe/2 nm Cu/5 nanometer Ta

(9-2)

This is to exemplify a so-called bottom-type spin valve film in which an antiferromagnetic layer is below a free layer. Fig. 6 is a conceptual view showing the spin valve film constitution of this Example. Precisely, the film illustrated comprises an antiferromagnetic film crystallization control layer 128 and an antiferromagnetic film 127 as laminated on a subbing buffer layer 131, and comprises pinned layers 126 and 124 as antiferromagnetically coupled to each other via a layer 125. On the layer 124, laminated are a spacer layer 123, a free layer 122 and a nonmagnetic high-conductivity layer 121 in that order. Finally provided is a cap layer 132 over them.

In the embodiment of (9-1), the antiferromagnetic film crystallization control layer 128 is a single layer of Ru, the

antiferromagnetic film 127 is of PtMn, and the free layer 122 is of a laminate film composed of two layers 129 and 130. In the embodiment of (9-2), the antiferromagnetic film crystallization control layer 128 is a two-layered film composed of a film 133 of Ru and a film 134 of NiFeCr, the antiferromagnetic film 127 is of IrMn, and the free layer 122 is of a two-layered film composed of two layers 129 and 130.

In the bottom-type spin valve film, the antiferromagnetic film crystallization control layer is provided over the buffer layer of Ta or the like, and it is a subbing film of fcc or hcp having a thickness of from 1 nanometer to 5 nanometers or so. For example, employed are alloy films or laminate films of Cu, Au, Ru, Pt, Rh, Ag, Ni, NiFe, etc. The seed layer is important for increasing the function of the antiferromagnetic film. In the embodiment of (9-1) incorporating PtMn, used is a single-layered Ru layer; while in (9-2) incorporating IrMn, used is a laminate film of Ru/NiFeCr. In the constitution with the antiferromagnetic film crystallization control layer of that type, the blocking temperature for the antiferromagnetic film could be elevated to a satisfactorily high level, the film planarization could be promoted, and low Hin could be realized even for the ultra-thin spacers of from 1.5 to 2.5 nanometers thick or so that are needed in the invention.

The bias point control to be effected in the invention